JOURNAL OF COMMUNICATION DISORDERS AND ASSISTIVE TECHNOLOGY

Aster Publications Research ISSN: 2576-3997

DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report

Carmichael CM

Woolfolk School of Communication Sciences and Disorders, Our Lady of the Lake University, San Antonio, TX, USA,

[*]**Corresponding author:** Christine M. Carmichael, Woolfolk School of Communication Sciences and Disorders, Our Lady of the Lake University, San Antonio, TX, USA, Tel: 210.434.6711 E-mail: ccarmichael@ollusa.edu

Received: Sep 30, 2017; Accepted: January 19, 2018; Published: January 22, 2018

Competing interests: The authors have declared that no competing interests exist.

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7.

ABSTRACT

Delayed auditory feedback (DAF) increases fluency in many persons who stutter. Individuals with Parkinson's disease (PD) present with voice and speech changes with some experiencing stuttering as an effect of the disease. The purpose of this case study was to investigate the use of DAF in a male who acquired stuttering associated with PD. The 79-year old wore a DAF device during 2 hours per week of speech therapy for 3 months. Results from this study show DAF during speech therapy increased fluency by nearly 20% and decreased dysfluency duration by almost 3 seconds.

Key Words: Delayed auditory feedback (DAF) , Parkinson's disease (PD)

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder that presents clinically with tremors, rigidity, bradykinesia, masked facies, and hypokinetic dysarthria including weak vocal intensity, monopitch, accelerated speech rate, imprecise articulation and poor speech intelligibility [1]. Occasionally, stuttering is acquired in patients with PD, contributing to unintelligible speech. Stuttering is a complex speech disorder which disrupts fluency of verbal output [2] and is characterized by involuntary repetitions, prolongations, hesitations, and blocks [3]. Although the etiology of acquired stuttering associated with PD is unknown, research has stated possible risk factors as abnormal function of the basal ganglia-thalamocortical motor circuits in the putamen [4], chronic effects of dopaminergic medications [5,6], and deep brain stimulation [2,7].

Therapy for stuttering includes fluency shaping which allows use of delayed auditory feedback (DAF), instrumentation that feeds the speaker's verbal output back into his ears after a short delay [8]. DAF is a helpful technique in the treatment of stuttering, increasing fluency in many individuals who stutter by as much as 70% [9-12]. Combining DAF with speech therapy trained participants to speak fluently 98% of the time [13]. There is some evidence that DAF is useful in individuals with PD who acquired stuttering [14-16]. Other research suggests that speakers with PD do not respond to DAF therapy [17,18].

DAF is most effective with a binaural system set at a 50 ms delay [10]. A short delay of 50 ms was found most beneficial in patients with PD/parkinsonism and hypokinetic dysarthria [9,19], while 100 ms and 150 ms resulted in reduced rate and improved intelligibility but increased pause frequency [20,21]. Optimum DAF delay has been defined as "the shortest delay which produces the maximum reduction in stuttering frequency" [9]; therefore, a 50 ms delay is preferred for the PD population.

Most studies on DAF in PD have concentrated predominantly on speech rate and intelligibility, some relating speaking rate to fluent speech while others showing that rate control is not associated with fluency [20-23]. Other parameters have been measured including articulation rate, intensity, pitch range, speech rhythm, naturalness, and vowel duration [9,14-17,20-23]. However, pause frequency and duration have been the only ones analyzed with a direct relationship to fluency for PD speakers who stutter [22].

Little is known about the effects of DAF on stuttering in PD. There are contradictory results in the literature regarding success with DAF in this population. This study investigated the effectiveness of DAF measuring frequency of dysfluencies, stutter duration, and overall stuttering severity in a patient with PD who acquired stuttering as a result of the disease.

MATERIALS AND METHODS

Participant

In this case study, a 79-year old male with Parkinson's disease and hypokinetic dysarthria wore a mini DAF device (Casa Futura Technologies School DAF) to reduce dysfluencies and aid in speech intelligibility. The participant

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7.

was diagnosed with idiopathic PD and hypokinetic dysarthria 10 years ago. In addition to motor symptoms (right upper limb tremor, festinating gait) and speech disorders (reduced vocal loudness, rapid speech rate, shortened maximum phonation time), the patient began stuttering (frequent blocking, hesitations, and initial consonant repetitions) 5 years ago. The participant began receiving speech services for vocal loudness and respiratory strength training approximately 6 years ago; however, did not receive fluency or DAF therapy until the initiation of this study. Currently, the participant has been classified in Hoehn & Yahr [24] stage IV.

Procedures

To establish a baseline, dysfluencies were initially measured during a 1-minute standard oral reading (The Grandfather Passage) and a 1-minute spontaneous speech sample. Both activities were a part of the patient's loudness therapy. Productions were recorded on a Lenovo Think Centre All-In-One with a Shure PG48 microphone. Mouth-to-microphone distance was 10 cm. Due to the inherent variability of daily symptoms in patients with PD, this multiple baseline design was repeated one week later.

DAF therapy consisted of 2 hours per week for 3 months during loudness sessions. The participant wore the DAF unit during his clinical loudness therapy sessions conducted by graduate student clinicians with supervision. The Casa Futura School DAF instrument is a miniature battery powered unit with a binaural Sennheiser PC131 full-size headset. Delay was set at 50 ms. Intensity of the device was set to the participant's comfort level. No instruction regarding fluency/DAF was provided during the loudness sessions except to introduce the unit and to calibrate DAF unit intensity to patient comfort.

Post-DAF therapy testing included the same 1-minute oral reading of The Grandfather Passage and a 1-minute spontaneous speech sample.

Measures

Measurements included frequency percentage of dysfluency = number of words stuttered divided by the total in each recorded one minute sample multiplied by 100 (frequency percentage). The duration of the three longest stuttering events was also measured and average duration of those events was calculated for each sample. Additionally, dysfluencies were typed and quantified into categories of blocking, hesitations, sound repetitions, and prolongations. Vocal intensity (loudness) was also measured.

Analysis

Samples were analyzed for intensity levels, stutter duration and hesitations/pauses using Audacity® (Windows), a free audio editing software program. Intensity was recorded each second of voice production and averaged (in dB); the 3 longest stutter durations were identified and averaged (in seconds); hesitations were calculated based on silent pauses (at least 200 ms) disregarding natural pauses (after punctuation, appropriate breath grouping).

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7.

Two speech pathologists listened to recordings in random order using Bose QuietComfort QC15 headphones to identify total syllables, percentage of syllables stuttered and number and type of dysfluencies for each sample.

Non-parametric tests were performed (Wilcoxon for two-related-samples and Mann-Whitney-U-Test for two-independent-samples) using SPSS 22.0. The level of significance was set to $p \leq 0.05$.

RESULTS

No significant difference was found across multiple baseline measures; therefore, an average stuttering frequency of 23.3% with an average duration of 4.2 seconds and average vocal intensity at 68.0 dB was accepted for the reading passage; spontaneous speech revealed an average stuttering frequency of 28.8% with an average duration of 4.8 seconds and average vocal intensity of 64.0 dB. Dysfluencies were averaged from the baseline samples for the reading and classified as 4 blocks, 11 hesitations and 13 initial consonant repetitions; spontaneous speech averaged 5.5 blocks, 12 hesitations and 13 initial consonant repetitions (Table 1).

	Baseline 1	**Average**	**Baseline 2**	**Post DAF**
Reading	122 words	120 words	118 words	113 words
Blocks	5	4	3	2
Hesitations	10	11	12	4
Repetitions	10	13	16	7
Frequency	20.5%	**23.3%**	26.2%	**2.65%***
Intensity	67 dB	**68 dB**	69 dB	**75 dB***
	Baseline 1	**Average**	**Baseline 2**	**Post DAF**
Conversation	101 words	106 words	111 words	97 words
Blocks	5	5.5	6	2
Hesitations	14	12	10	4
Repetitions	12	13	14	4
Frequency	*30.7%*	**28.8%**	*27.0%*	**10.3%***
Intensity	66 dB	**64 dB**	65 dB	**72 dB***

Table 1: Baseline and post DAF values. *p≤0.05

Frequency of stuttering after DAF averaged 2.65% ($p = 0.003$) with a 0.94 second average duration ($p = 0.014$) and average loudness of 75 dB ($p = 0.053$) for the reading passage (Table 1). For spontaneous speech, stuttering frequency averaged 10.3% ($p = 0.011$) with a 1.2 second average duration ($p = 0.033$) and average loudness of 72 dB ($p = 0.042$).

Overall, the participant had almost a 20% average reduction in dysfluencies and an increase in vocal loudness averaging nearly 8 dB after the DAF therapy.

CONCLUSION

In this case study, evidence showed that a patient with acquired stuttering associated with PD had significant improvements in fluency through the use of DAF. Increased loudness was a secondary benefit of the device, possibly indicating the Lombard effect or greater physiological effort [16], although loudness therapy that the participant attended while wearing the DAF unit likely contributed.

The use of DAF in the clinical management of speech disorders is not novel. DAF has been used as an adjunct to treatment for stuttering in those with developmental stuttering. However, the research has shown mixed results with DAF in PD. Most studies evaluating DAF in PD measure intelligibility and speaking rate. Quite often, dysarthria assessments are used [17,21] instead of evaluations specific to fluency and dysfluencies. This study focused on using DAF to reduce stuttering in a patient with PD by specifically analyzing measures of fluency. Brendel et al. [22] measured pause frequency and pause duration. Blanchet & Hoffman [25] calculated fluency percentage and typed dysfluencies in a study evaluating effects of clinician instruction on DAF.

The data from this study affirm implications for DAF use in clinical practice with PD populations who experience acquired stuttering. First of all, DAF should be considered as an instrumental therapy method in these individuals. Secondly, clinicians and researchers should evaluate effectiveness of this therapeutic method using specific assessment procedures already defined for fluency disorders in order to measure frequency of speech fluency and severity of observed dysfluencies [26].

Although future DAF research on larger PD populations, long-term effects/adaptation of DAF, and DAF detraining is warranted, results from this study using DAF to reduce stuttering in PD should encourage further testing.

REFERENCES

1. Duffy JR. Motor Speech Disorders: Substrates, Differential Diagnosis, and Management. 3rd ed. St Louis: Elsevier Health Sciences; 2013.

2. Toft M, Dietrichs E. Aggravated stuttering following subthalamic deep brain stimulation in Parkinson's disease – two cases. BMC Neurol. 2011; 11:44.

3. World Health Organization. Manual of international statistical classification of diseases, injuries, and causes of death. Geneva (Switzerland): World Health Organization; 1977. v 1.

4. Alm PA. Stuttering and the basal ganglia circuits: a critical review of possible relations. J Commun Disord. 2004; 37(4): 325-369.

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7..

5. Tykalova T, Rusz J, Cmejla R, Klempir J, Ruzickova H, et al. Effect of dopaminergic medication on speech dysfluency in Parkinson's disease: a longitudinal study. J Neural Transm. 2015; 122(8): 1135-1142.

6. Louis ED, Winfield L, Fahn S, Ford B. Speech dysfluency exacerbated by levodopa in Parkinson's disease. Mov Disord. 2001; 16(3): 562-565.

7. Picillo M, Vincos GB, Sammartino F, Lozano AM, Fasano A. Exploring risk factors for stuttering development in Parkinson disease after deep brain stimulation. Parkinsonism Relat Disord. 2017; 38: 85-89.

8. Borsel JV, Sierens S, Pereira MM. Using delayed auditory feedback in the treatment of stuttering: evidence to consider. Pro-Fono de Atualizacao Cientifica. 2007; 19(3): 323-332.

9. Kalinowski J, Armson J, Roland-Mieszkowski M, Stuart A, Gracco VL. Effects of alterations in auditory feedback and speech rate on stuttering frequency. Lang Speech. 1993; 36(9): 1-16.

10. Stuart A, Kalinowski J, Rastatter MP. Effect of monaural and binaural altered auditory feedback on stuttering frequency. J Acoustic Soc Am. 1997; 101(6): 3806-3809.

11. Borsel JV, Reunes G, Van den Bergh N. Delayed auditory feedback in stuttering. Clients as consumers. Int J Lang Commun Dis. 2003; 38(2): 119-129.

12. Macleod J, Kalinowski J, Start A, Armson J. Effect of single and combined auditory feedback on stuttering frequency at two speech rates. J Commun Dis. 1995; 28(3): 217-228.

13. Ryan BP, Van Kirk B. The establishment, transfer, and maintenance of fluent speech in 50 stutterers using delayed auditory feedback and operant procedures. J Speech Hear Disord. 1974; 39(1): 3-10.

14. Coutinho SB, Diaferia G, Oliveira G, Behlau M. Voice and speech of individuals with Parkinson's disease during amplification, delay and masking situations. Pro Fono Revista de Atualizacao Cientifica. 2009; 21(3): 219-224.

15. Downie AW, Low JM, Lindsay DD. Speech disorder in parkinsonism--usefulness of delayed auditory feedback in selected cases. Br J Disord Commun. 1981; 16(2), 135-139.

16. Hanson WR, Metter EJ. DAF speech rate modification in Parkinson's disease: a report of two cases. In Berry W (ed): Clinical Dysarthria. Austin, TX: Pro-Ed; 1983; 231-254.

17. Dagenais PA, Southwood MH, Lee TL. Rate reduction methods for improving speech intelligibility of dysarthric speakers with Parkinson's disease. J Med Speech Lang Pathol. 1998; 6(3): 143-157.

18. Howell P. Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. Stammering Res. 2004; 1(1): 31-46.

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7.

19. Rosenbek JD, Wertz RT, Collins M, Delayed auditory feedback in the treatment of dysarthric adults, American Speech and Hearing Association, 1976, Houston, TX.

20. Van Nuffelen G, De Bodt M, Wuyts F, Van de Heyning P. The effect of rate control on speech rate and intelligibility of dysarthric speech. Folia Phoniatr Logop. 2009; 61(2):69-75.

21. Rousseau B, Watts CR. Susceptibility of speakers with Parkinson disease to delayed feedback. J Med Speech Lang Pathol. 2002; 10: 41-49.

22. Brendel B, Lowit A, Howell P. The effects of delayed and frequency shifted feedback on speakers with Parkinson's disease. J Med Speech Lang Pathol. 2004; 12: 131-138.

23. Van Nuffelen G, De Bodt M, Vanderwegen J, Van de Heyning P, Wuyts F. Effect of rate control on speech production and intelligibility in dysarthria. Folia Phoniatr Logop. 2010; 62(3): 110-119.

24. Hoehn MM, Yahr MD. Parkinsonism: onset, progression, and mortality. Neurology. 1967; 17(5): 427-442.

25. Blanchet PG, Hoffman PR. Factors influencing the effects of delayed auditory feedback on dysarthric speech associated with Parkinson's disease. Commun Disord Deaf Stud Hearing Aids. 2014; 2[1]: 1-11.

26. Yaruss JS, Quesal RW. Stuttering and the International Classification of Functioning, Disability, and Health (ICF): An update. Journal of Communication Disorders. 2004; 37(1): 35-52.

Cite as: Carmichael CM. DAF as Instrumental Treatment for Stuttering in Parkinson's Disease: A Case Report. J Commun Disorder Assist Technol. 2018; 1: 1-7.